CLAIMS

1. A nonwoven fabric comprising an aggregate of carbon fibers having a fiber diameter of 0.001 to 2 μm.

2. The nonwoven fabric of claim 1, wherein the fiber diameter is 0.01 to 1 μm.

3. The nonwoven fabric of claim 1, wherein the fiber diameter is 0.05 to 0.5 μm.

4. The nonwoven fabric of claim 1, having a density of the carbon fibers per unit area of 1 to 1,000 g/m^2.

5. The nonwoven fabric of claim 1, having a density of the carbon fibers per unit area of 2 to 500 g/m^2.

6. The nonwoven fabric of claim 1, having a porosity of 60 to 98%.

7. The nonwoven fabric of claim 1, having a porosity of 80 to 98%.

8. The nonwoven fabric of claim 1, having a porosity of 90 to 98%.

9. The nonwoven fabric of claim 1, having a water contact angle of 140 to 155° at 20°C and a relative humidity of 65 to 70%.

10. The nonwoven fabric of claim 1, having a thickness of 5 μm to 2 cm.

11. The nonwoven fabric of claim 1, having a thickness of 5 μm to 1 mm.

12. The nonwoven fabric of claim 1, wherein the carbon fibers do not have a branch structure.

13. The nonwoven fabric of claim 1, wherein the carbon fibers are porous.

14. The nonwoven fabric of claim 1, wherein the carbon fibers satisfy the following formula (1):

$$30 < L/D \quad (1)$$

wherein L is the fiber length (μm) of the carbon fibers and D is the fiber diameter (μm) of the carbon fibers.

15. A substrate for fuel cell electrodes which comprises the nonwoven fabric of claim 1 or a pulverized material thereof.

16. A precursor for fuel cell electrodes which comprises the nonwoven fabric of claim 1 and in which a catalyst comprising carbon powder that carries platinum or a platinum alloy is bound by use of polytetrafluoroethylene as a binder.

17. The precursor of claim 16, wherein the carbon powder is a material obtained from pulverizing the nonwoven fabric of claim 1.

18. A precursor for fuel cell electrodes which comprises the nonwoven fabric of claim 1 and in which a catalyst comprising platinum or a platinum alloy is bound by use of polytetrafluoroethylene as a binder.

19. A precursor for fuel cell electrodes which comprises a carbon fiber fabric in which a catalyst comprising a pulverized material of the nonwoven fabric of claim 1 carrying platinum or a platinum alloy, is bound by use of polytetrafluoroethylene as a binder.

20. An electrode material comprising a pulverized material of the nonwoven fabric of claim 1.

21. The electrode material of claim 20 which is used for a secondary cell.

22. The electrode material of claim 20 which is used for a capantor.

23. An electrode material comprising the nonwoven fabric of claim 13 or a pulverized material thereof.

24. The electrode material of claim 23 which is used for a capantor.

25. The electrode material of claim 23, wherein the porous carbon fibers constituting the nonwoven fabric of claim 13 have fine pores having a fine pore diameter of 0.1 to 200 nm on the surfaces thereof.

26. The electrode material of claim 24, wherein the ratio of the specific surface area of fine pores having a fine pore diameter of 2 nm or larger to the total specific surface area is 0.3 or higher.

27. The electrode material of claim 26, wherein

the total specific surface area is 100 to 50,000 m^2/g.

28. A composite material comprising a matrix material and the nonwoven fabric of claim 1 or a pulverized material thereof which is contained in the matrix material.

29. The composite material of claim 28, wherein the matrix material is an organic polymer or an inorganic compound.

30. The composite material of claim 29, wherein the organic polymer is selected from the group consisting of polyolefin polyamide, polyester, polycarbonate, polyimide, polyether, polyphenylene, polysulfone, polyurethane and an epoxy resin.

31. The composite material of claim 29, wherein the inorganic compound is selected from the group consisting of aluminum oxide, silicon carbide, silicon nitride, boron nitride and inorganic glass.

32. A metal-carrying nonwoven fabric or metal-carrying pulverized material which comprises 100 parts by weight of the nonwoven fabric of claim 3 or a pulverized material thereof and 0.1 to 100 parts by weight of metal compound carried on the carbon fibers which constitute the nonwoven fabric or pulverized material thereof.

33. The metal-carrying nonwoven fabric or metal-carrying pulverized material of claim 32, wherein the metal compound is a photocatalyst.

34. The metal-carrying nonwoven fabric or metal-carrying pulverized material of claim 32, wherein the form of the metal compound carried is a thin film having a film thickness of 1 to 100 nm or particles having a particle size of 1 to 100 nm.

35. A filter substrate comprising the metal-carrying nonwoven fabric or metal-carrying pulverized material of claim 32.

36. A water treatment or air cleaning filter comprising the filter substrate of claim 35.

37. A method for producing a nonwoven fabric comprising an aggregate of carbon fibers, comprising:
(1) a step of forming an aggregate of precursor fibers from a mixture comprising 100 parts by weight of thermoplastic resin and 1 to 150 parts by weight of at least one thermoplastic carbon precursor selected from the group consisting of pitch, polyacrylonitrile, polycarbodiimide, polyimide, polybenzoazol and aramid, in accordance with a melt blow method,
(2) a step of forming an aggregate of stabilized precursor fibers by subjecting the above aggregate of precursor fibers to a stabilization treatment to stabilize the thermoplastic carbon precursor in the precursor fibers,
(3) a step of forming an aggregate of fibrous carbon precursor by removing the thermoplastic resin from the aggregate of stabilized precursor fibers, and
(4) a step of carbonizing or graphitizing the aggregate of fibrous carbon precursor.

38. The method of claim 37, wherein the fiber

diameter of the precursor fibers formed in the step (1) is 0.01 to 20 μm.

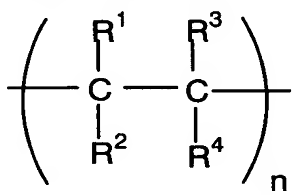
39. The method of claim 37, wherein the fiber diameter of the precursor fibers formed in the step (1) is 0.05 to 10 μm.

40. The method of claim 37, wherein in the step (2), the stabilization treatment is carried out in a halogen/oxygen mixed gas.

41. The method of claim 40, wherein iodine is used as the halogen gas.

42. The method of claim 37, wherein the pitch is mesophase pitch.

43. The method of claim 37, wherein the thermoplastic resin is a thermoplastic resin represented by the following formula (I):



(I)

wherein R^1, R^2, R^3 and R^4 are each independently selected from the group consisting of a hydrogen atom, an alkyl group having 1 to 15 carbon atoms, a cycloalkyl group having 5 to 10 carbon atoms, an aryl group having 6 to 12 carbon atoms and an aralkyl group having 6 to 12 carbon atoms, and n represents an integer of 20 or larger.

44. The method of claim 43, wherein the thermoplastic resin is poly-4-methylpentene-1 or a

copolymer thereof.

45. The method of claim 43, wherein the thermoplastic resin is a polyethylene.

46. The method of claim 37, wherein after the step (4), (5) a step of firing the fibrous carbon precursor at 1,500°C or lower and then subjecting the fired precursor to an activation treatment is further carried out to produce porous carbon fibers.

47. The method of claim 46, wherein the activation treatment is a treatment with water vapor and/or metal hydroxide.